

# Claims

- [c1] 1. A silicon oxide gap-filling process, comprising:  
providing a substrate having a trench thereon, wherein  
an aspect ratio of the trench is 4.0 at least; and  
performing a CVD process having an etching effect to fill  
up the trench with silicon oxide, wherein reaction gases  
used in the CVD process comprise deposition gases and  
He/H<sub>2</sub> mixed gas as a sputtering-etching gas, wherein  
the percentage of the He/H<sub>2</sub> mixed gas in the total reac-  
tion gases is 70% at least.
- [c2] 2. The silicon oxide gap-filling process of claim 1,  
wherein the CVD process comprises an HDP-CVD pro-  
cess.
- [c3] 3. The silicon oxide gap-filling process of claim 1,  
wherein a ratio of He to H<sub>2</sub> (He/H<sub>2</sub> ratio) in the He/H<sub>2</sub>  
mixed gas is 0.3–4.0.
- [c4] 4. The silicon oxide gap-filling process of claim 1,  
wherein an ED ratio of the CVD process is 0.1–0.03.
- [c5] 5. The silicon oxide gap-filling process of claim 1,  
wherein the deposition gases comprise SiH<sub>4</sub> and O<sub>2</sub>.

- [c6] 6. The silicon oxide gap-filling process of claim 5, wherein in the CVD process, a flow rate of  $\text{SiH}_4$  is 20–100sccm, a flow rate of  $\text{O}_2$  is 40–200sccm, a flow rate of  $\text{H}_2$  is 100–2000sccm, a flow rate of He is 200–2000sccm, a pressure is 5–20mTorr, a temperature is 400–650°C, a low-frequency RF power is 3000–15000W, and a high-frequency RF power is 500–5000W.
- [c7] 7. The silicon oxide gap-filling process of claim 1, which is applied to an STI process in a 90nm semiconductor process.
- [c8] 8. A silicon oxide gap-filling process, comprising:  
providing a substrate having a trench thereon;  
performing a CVD process having an etching effect to fill up the trench with silicon oxide, wherein reaction gases used in the CVD process comprise deposition gases and  $\text{He}/\text{H}_2$  mixed gas as a sputtering-etching gas, and a percentage of the  $\text{He}/\text{H}_2$  in the total reaction gases is raised with increase of an aspect ratio of the trench.
- [c9] 9. The silicon oxide gap-filling process of claim 8, wherein the CVD process comprises an HDP-CVD process.
- [c10] 10. The silicon oxide gap-filling process of claim 8,

which is applied to an STI process.

- [c11] 11. The silicon oxide gap-filling process of claim 8, wherein the aspect ratio of the trench is higher than 3, and the ratio of He to H<sub>2</sub> (He/H<sub>2</sub> ratio) in the He/H<sub>2</sub> mixed gas is 0.3–4.0.
- [c12] 12. The silicon oxide gap-filling process of claim 11, which is applied to an STI process in a semiconductor process under 0.13  $\mu$ m.
- [c13] 13. The silicon oxide gap-filling process of claim 11, wherein an ED ratio of the CVD process is 0.1–0.03.
- [c14] 14. The silicon oxide gap-filling process of claim 8, wherein the deposition gases comprise SiH<sub>4</sub> and O<sub>2</sub>.
- [c15] 15. The silicon oxide gap-filling process of claim 14 wherein in the CVD process, a flow rate of SiH<sub>4</sub> is 20–100sccm, a flow rate of O<sub>2</sub> is 40–200sccm, a flow rate of H<sub>2</sub> is 100–2000sccm, a flow rate of He is 200–2000sccm, a pressure is 5–20mTorr, a temperature is 400–650°C, a low-frequency RF power is 3000–15000W, and a high-frequency RF power is 500–5000W.
- [c16] 16. A silicon oxide gap-filling process, comprising:  
providing a substrate having a trench thereon;

performing an HDP-CVD process to fill up the trench with silicon oxide, wherein reaction gases used in the HDP-CVD process comprise  $\text{SiH}_4$ ,  $\text{O}_2$ , He and  $\text{H}_2$ , wherein a flow rate of  $\text{SiH}_4$  is 20–100sccm, a flow rate of  $\text{O}_2$  is 40–200sccm, a flow rate of  $\text{H}_2$  is 100–2000sccm, a flow rate of He is 200–2000sccm, a pressure is 5–20mTorr, a temperature is 400–650°C, a low-frequency RF power is 3000–15000W, and a high-frequency RF power is 500–5000W; an ED ratio of the HDP-CVD process is 0.1–0.03; and a percentage of the He/ $\text{H}_2$  in the total reaction gases is raised with increase of an aspect ratio of the trench.

- [c17] 17. The silicon oxide gap-filling process of claim 16, wherein the aspect ratio of the trench is higher than 3, and the ratio of He to  $\text{H}_2$  (He/ $\text{H}_2$  ratio) in the He/ $\text{H}_2$  mixed gas is 0.3–4.0.
- [c18] 18. The silicon oxide gap-filling process of claim 17, which is applied to an STI process in a semiconductor process under 0.13 $\mu\text{m}$ .
- [c19] 19. The silicon oxide gap-filling process of claim 17, wherein the aspect ratio of the trench is 4.0 at least, and the percentage of the He/ $\text{H}_2$  mixed gas is 70% at least.

[c20] 20. The silicon oxide gap-filling process of claim 19, which is applied to an STI process in a 90nm semiconductor process.